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PATENT SPECIFICATION

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

Concentration of Thixotropic Compositions

We, TECHNION RESEARCH AND DEVELOPMENT FOUNDATION LIMITED, a Company organised under the Laws of Israel, of Technion Building, Haifa, Israel, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to a method and apparatus for the concentration of thixotropic compositions i.e. compositions whose viscosity is reduced by the application of shearing forces. In the following description the invention will be described with particular reference to the concentration of vegetable extracts, it being understood that the invention is not limited to the concentration of said extracts and is applicable to any thixotropic composition capable of being concentrated.

It is known that the viscosity of vegetable concentrates such as for example fruit juice is a limiting factor in any further concentration. Thus, for example, in the case of orange juice, it is difficult to concentrate above a soluble solid material content of 65 to 67%. Beyond this concentration the higher viscosity reduces the rate of heat transfer to such an extent that scorching and browning becomes inevitable.

We have discovered that if the viscosity of the thixotropic composition is sufficiently reduced by the action of ultrasonic waves, the composition can then be concentrated without overheating.

The invention accordingly consists in a process for treating a thixotropic composition wherein the composition is subjected to the action of ultrasonic waves for such a period of time that the viscosity is substantially reduced, and the composition is sub-

sequently concentrated by solvent evaporation.

Where the concentration is effected in stages it is possible in accordance with the method of the present invention to precede each individual evaporation stage by an ultrasonic treatment. The invention may also be carried out by continuously recycling the product withdrawn from an evaporator back through the ultrasonic treatment unit into the evaporator. In this manner the concentration is increased gradually up to the desired level.

The ultrasonic treatment may incorporate the use of ultrasonic waves at a frequency of for example between 20,000 and 100,000 cycles per second although a convenient value may be 20,000 cycles per second. The period of treatment may vary up to 60 minutes but may conveniently be about 5 minutes.

By means of the process according to the invention, fruit juices of a concentration of 75° to 80° Brix can be prepared. The preparation of juices or rather purees of such a high concentration is very desirable since at this level of concentration no special measures for preservation such as pasteurization or freezing have to be taken. All that is required with such a product is to store it under refrigeration so as to prevent non-enzymatic browning. Such a degree of concentration could hitherto not be achieved even with modern evaporators containing heat exchangers designed to cause a high turbulence of the concentrate, in spite of the fact that in such evaporators the apparent viscosity of the heated medium is reduced due to high shear-rate. Moreover in the case where hitherto multi stage concentration was practised in short-time continuous evaporators, the retention time in the final stages necessary for obtaining a high

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degree of concentration was unduly long, mainly because of the low heat conductivity of the highly viscous film of concentrate.

The highly concentrated juices obtained by the process of the present invention are considerably less viscous than would be the case if concentrates of the same degree of concentration were prepared in a conventional manner, and this state of comparatively reduced viscosity appears to be permanent. Thus, for example, the viscosity of a 70° Brix orange juice concentrate prepared by the process of the invention was only 1.5 times that of the original 60° Brix concentrate. On the other hand, the viscosity of a 70° Brix concentrate obtained by evaporation without ultrasonic treatment was almost 8 times that of the original 60° Brix concentrate.

The invention also provides an apparatus for the concentration of a thixotropic composition comprising means for the ultrasonic treatment of the composition, an evaporator, and means for conducting the composition from said ultrasonic treatment means to the evaporator.

One embodiment of the invention is illustrated by way of example in the accompanying drawing which is a diagrammatic representation.

The apparatus comprises an evaporator 1 having an adaptor 2 for connection to a condenser (not shown), an inlet duct 3 for feeding the composition to be concentrated and an outlet duct 4 for the discharge of the concentrated product. The apparatus further comprises an ultrasonic treatment unit 5, a heater 6, a pump 7 and an outlet duct 8 for the take-off of the final product. During operation, the treated composition is circulated continuously from the evaporator through the ultrasonic treatment unit 5 and the heater 6 back into the evaporator and in this manner a gradual concentration takes place. When the final degree of concentration is reached the product is discharged through the outlet 8.

The process of the invention is illustrated by the following two examples in which the relative viscosity measurements were effected by comparing the time of flow in a No. 400 Ostwald Pipette. Where concentrates of different degrees of concentration were compared, correction was made for the differences in specific gravity.

EXAMPLE 1:

50 g of commercial Shamouti orange juice concentrate with a soluble solids content of 60° Brix, was subjected to ultrasonic waves at a frequency of 20,000 cycles per second. The ultrasonic generator had a power output of 60 watts. The relative viscosity of the sample decreased as follows:

Period of treatment minutes	Relative viscosity	
0	100	65
2	85	
4	64	
7	53	70
12	31	
15	26	

This example illustrates the very pronounced lowering of the viscosity by a suitable ultrasonic treatment. The applicability of this phenomenon in the concentration of orange juice is illustrated in the following example.

EXAMPLE 2:

A commercial sample of Shamouti orange juice concentrate, as described in Example 1, was subjected to ultrasonic treatment for ten minutes by means of the apparatus described in Example 1, and then concentrated, under reduced pressure to a soluble solids content of 63° Brix. The material was given another ten minutes of ultrasonic treatment and further concentrated to 70° Brix. The viscosity of this 70° Brix concentrate was only 150% of that of the original 60° Brix concentrate. The viscosity of a 70° Brix concentrate obtained without ultrasonic treatment was 700% that of the original 60° Brix concentrate. The sample concentrated in this way was capable of further concentration without scorching and browning.

WHAT WE CLAIM IS:—

1. A process for treating a thixotropic composition wherein the composition is subjected to the action of ultrasonic waves for such a period of time that the viscosity is substantially reduced and the composition is subsequently concentrated by solvent evaporation.
2. A process as claimed in Claim 1, wherein the composition to be concentrated is cycled continuously in a closed cycle incorporating an evaporation stage and an ultrasonic treatment stage until the desired degree of concentration has been reached.
3. A process as claimed in Claim 1 or 2 wherein the ultrasonic treatment incorporates the use of ultrasonic waves at a frequency between 20,000 and 100,000 cycles per second.
4. A process as claimed in any of the preceding claims wherein the ultrasonic treatment is applied for a period between 5 and 60 minutes.
5. A process for treating a thixotropic composition substantially as described with reference to Example 2.
6. Apparatus for the concentration of a thixotropic composition comprising means for the ultrasonic treatment of the composition, an evaporator, and means for repeatedly recycling the composition through said ultrasonic treatment means and the evaporator.

7. Apparatus for the concentration of a thixotropic composition constructed and operating substantially as described with reference to the accompanying drawing.

For the Applicants:
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1 SHEET

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the Original on a reduced scale.*

